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(54) **Electromagnetic-shielding gasket or sealing member**

(57) An electromagnetic-shielding gasket or sealing member (1) has a body (15) formed of a synthetic resin, such as an elastomer, and a conductive membrane (17) applied by an evaporation process onto the surface of the body.

FIG. 2

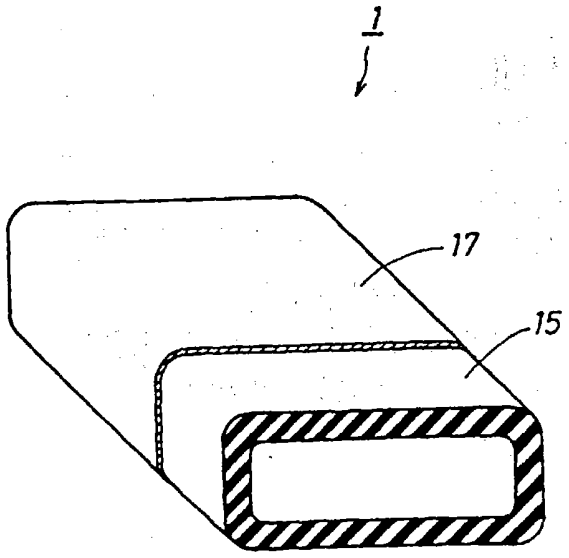

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FIG. 1

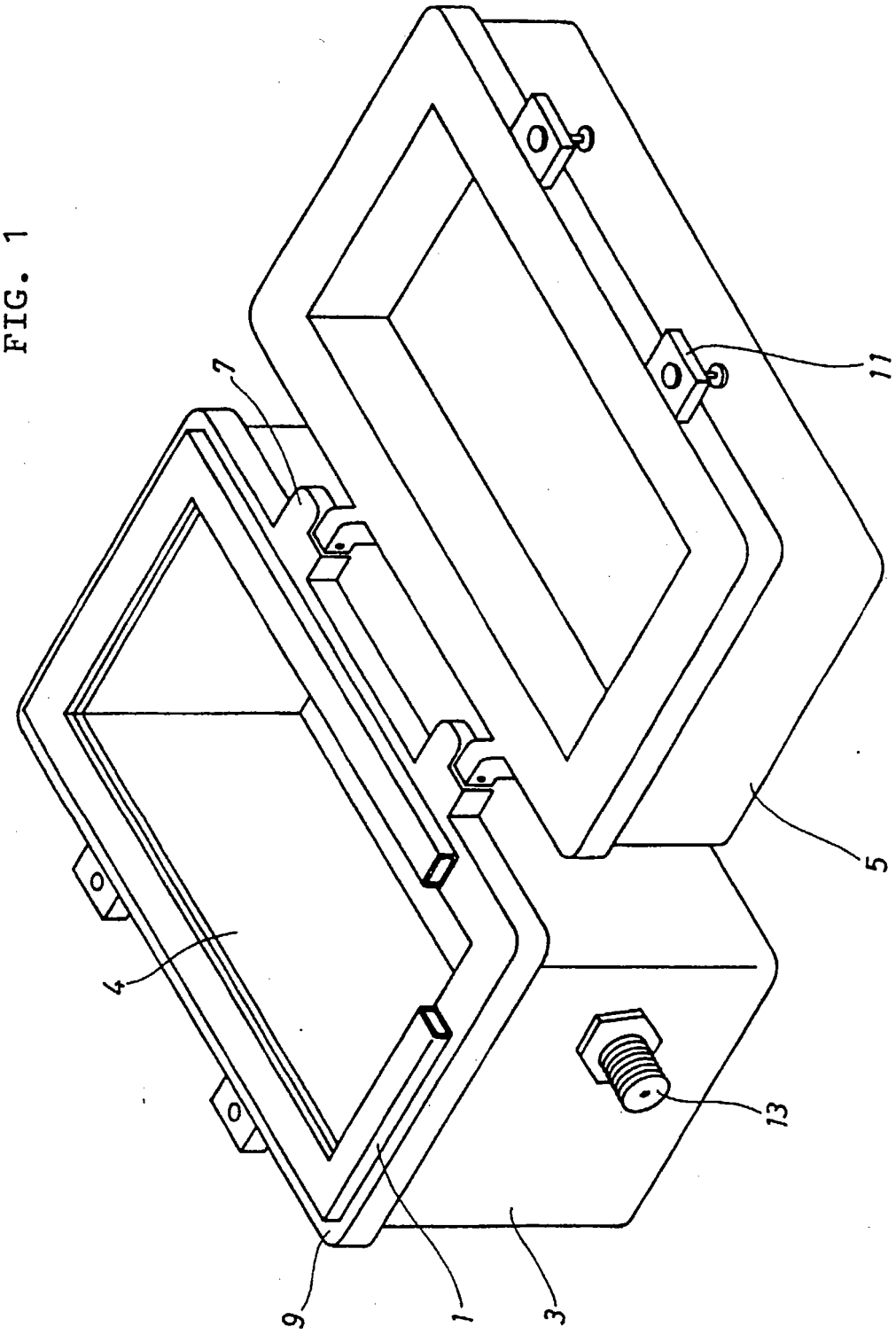


FIG. 2

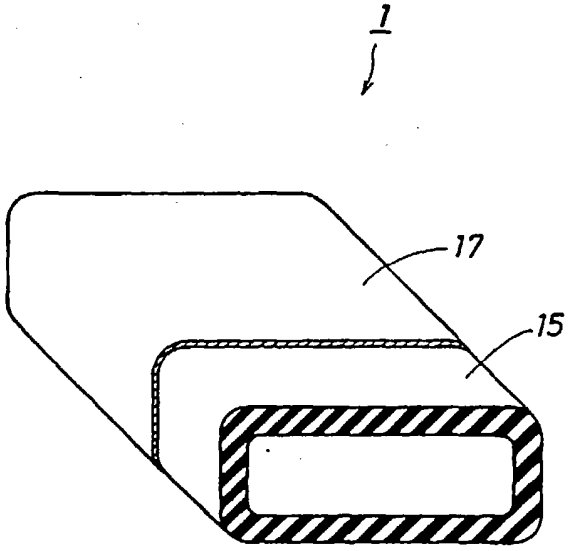


FIG. 3

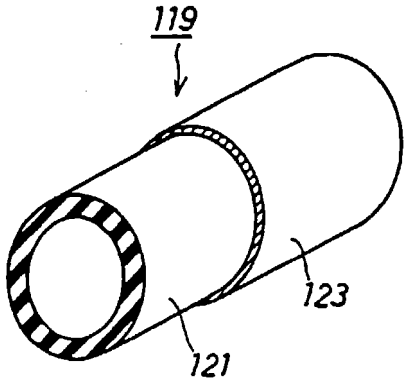


FIG. 4

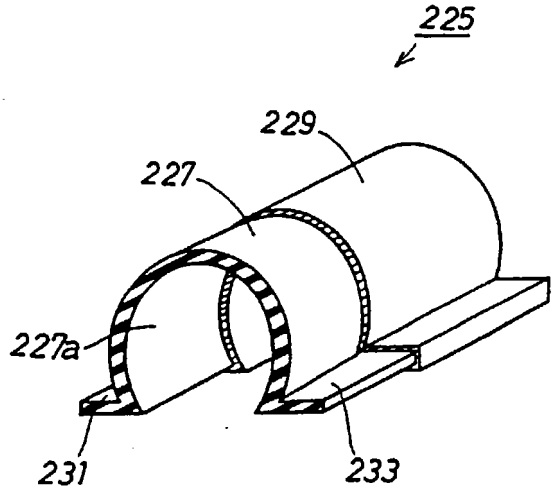


FIG. 5

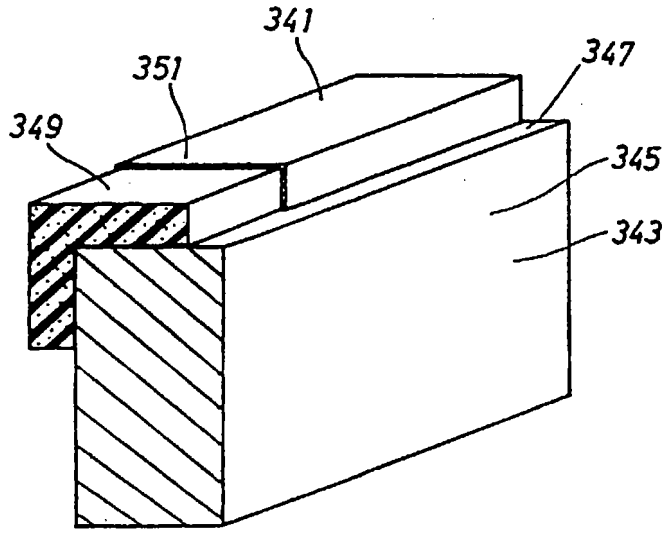


FIG. 6

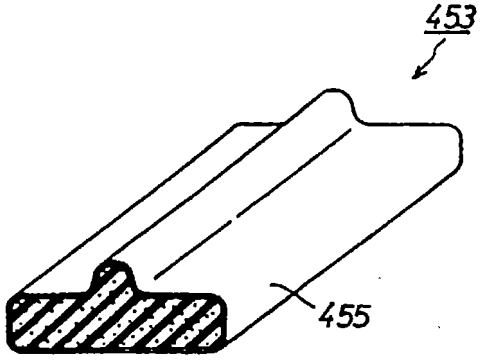
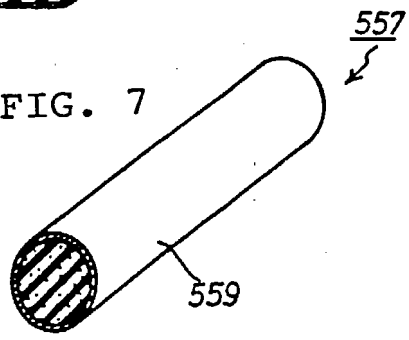


FIG. 7



elastomer gasket") to prevent electromagnetic waves from passing to the electronic components.

However, neither the "metallic gasket" nor the "elastomer gasket" sufficiently shield the electronic components from electromagnetic waves, and each has problems.

The housing for the electronic components must be airtight or watertight depending on the environment in which the electronic components operate. For example, the location where a washing machine is operated is very humid. Where automobiles operate, various different environments are possible. Thus airtightness and watertightness are required for the electronic-component housing for washing machines and automobiles. The electromagnetic-shielding gasket or seal must have conductivity or low electrical resistivity to shield the electronic components from electromagnetic radiation and noise. The electromagnetic-shielding gasket or seal must also be elastic so that the gasket can seal any gap in the housing to make the housing airtight or watertight. However, the related-art "metallic gasket" cannot resiliently deform or completely seal the housing.

On the other hand, the related-art "elastomer gasket" has high conductivity because the gasket contains conductive metallic particles or carbon black (referred to as "conductive particles"). The gasket also has elasticity because its base material is an elastomer. When the content of conductive particles is increased, the electrical resistivity is reduced. However, when the content of conductive particles exceeds a fixed amount, the elasticity of the base material deteriorates. Consequently, the content of conductive particles has an upper limit. However, even at that upper limit, the "elastomer gasket" cannot sufficiently shield the housing from electromagnetic

radiation and noise.

According to the present invention there is provided an electromagnetic-shielding gasket or sealing member for sealing gaps and for preventing electromagnetic waves from passing through the gaps, comprising

a gasket or seal body formed of a synthetic elastomeric resin material, and

a conductive membrane applied by an evaporation process onto a surface of the gasket or seal body.

The electromagnetic-shielding gasket or seal seals gaps that remain after several members are connected, and prevents electromagnetic waves from passing through the gaps.

Some embodiments of the present invention will now be described, by way of examples, with reference to the accompanying drawings, in which:-

Figure 1 is a partially sectioned perspective view of a housing for electronic components provided with a first embodiment of a gasket embodying the present invention;

Figure 2 is a sectional perspective view of the electromagnetic-shielding gasket shown in Figure 1;

Figure 3 is a sectional perspective view of a second embodiment of an electromagnetic-shielding gasket embodying the present invention;

Figure 4 is a sectional perspective view of a third embodiment of an electromagnetic-shielding gasket embodying the present invention;

Figure 5 is a sectional perspective view of a fourth embodiment of an electromagnetic-shielding gasket embodying the present invention;

Figure 6 is a sectional perspective view of a fifth embodiment of an electromagnetic-shielding gasket embodying the present invention; and

Figure 7 is a sectional perspective view of a

sixth embodiment of an electromagnetic-shielding gasket embodying the present invention.

An electromagnetic-shielding gasket 1 is applied to the rim of a housing 3 that is provided with a movable lid 5. Embodiments of the electromagnetic-shielding gasket are explained with reference to the drawings.

In Figure 1, an electromagnetic-shielding gasket 1 which constitutes a first embodiment of the present invention is attached to a box-like housing 3 that houses electronic components. The housing 3, which is metallic, has an opening 4 for housing electronic components. A metallic lid 5 is pivotably connected by hinges 7 to the housing 3 so as to be able to close the opening 4.

The electromagnetic-shielding gasket 1 is attached by means of a conductive adhesive to a rim 9 that abuts the lid 5 when the lid 5 is closed. The housing 3 and the lid 5 have fasteners 11 to cause the lid 5 to be held tightly in contact with the electromagnetic-shielding gasket 1 when the lid 5 closes the housing 3, thus sealing the electronic components in the housing 3. An electrical conductor (not shown) for the electronic components in the housing 3 passes through a waterproof connector 13 in the side wall of the housing 3.

As shown in Figure 2, the electromagnetic-shielding gasket 1 has a rectangular section. An aluminium layer 17 of about four microns thick is applied by an evaporation process onto the surface of a gasket body 15 consisting of silicone rubber. An embodiment of the electromagnetic-shielding gasket 1 has the following physical properties, a tensile strength of 56 kg/cm^2, an elongation of 270%, and a surface resistivity of 7×10^{-3} ohm/cm^2.

Since the electromagnetic-shielding gasket 1 is covered with a uniformly thick aluminium layer 17 with a

low surface resistivity, the electronic components in the housing 3 are sufficiently shielded from externally generated electromagnetic waves, thus preventing electromagnetic radiation and noise from causing malfunctioning of the electronic components.

The base material of the body 15 of the electromagnetic-shielding gasket 1 is an elastomer such as a silicone rubber, thus providing elasticity and low electrical resistivity. By sealing the gap between the housing 3 and the lid 5, the electromagnetic-shielding gasket 1 securely seals against electromagnetic waves.

In this embodiment, the base material of the gasket body 15, silicone rubber, does not contain any conductive particles, unlike the related-art gasket. Instead, the aluminium layer 17 is evaporated onto the surface of the gasket body 15, thus not affecting the elasticity of the gasket body 15. Consequently, when the lid 5 is closed, the housing 3 is securely sealed against external humidity and air.

Since the electromagnetic-shielding gasket 1 has a rectangular section and thus a simple configuration, the cost of manufacturing a metallic mould for its manufacture is not expensive.

As shown in Figure 3, an electromagnetic-shielding gasket 119 constituting the second embodiment is cylindrical in cross-section. A titanium layer 123 of about two microns in thickness is applied by an evaporation process on the surface of a gasket body 121 formed of silicone rubber. Since the titanium layer 123 is durable, this embodiment can be used even in a severe embodiment.

As shown in Figure 4, an electromagnetic-shielding gasket 225 constituting a third embodiment has a part-circular cross-section. An aluminium layer 229 of about three microns in thickness is applied by an evaporation process onto the surface of the gasket body 227 which is

formed of a silicone rubber. The electromagnetic-shielding gasket 225 has flat flanges 231 and 233 extending longitudinally along the gasket 225, which facilitate the mounting of the gasket 225 on the housing. The aluminium layer 229 applied by an evaporation process can be applied to or omitted from the inner periphery 227a of the gasket body 227.

An electromagnetic-shielding gasket 341 constituting a fourth embodiment is made of a sponge-like rubber. As shown in Figure 5, the electromagnetic-shielding gasket 341 is used, in the same way as the other embodiments, in the clearance between the housing 343 and its lid. The electromagnetic-shielding gasket 341, which has an L-shaped cross-section, is placed on an upper end 347 of a side wall 345 of the housing 343. The base material of the electromagnetic-shielding gasket 341 is preferably a flexible foamed elastomer. A gasket body 349 could be manufactured, for example, by blowing air into unvulcanised latex, or by adding a foaming agent such as sodium bicarbonate to a masticated elastomer. An aluminium layer 351 about four microns in thickness is applied by an evaporation process onto the surface of the gasket body 349. The electromagnetic-shielding gasket 341 of the fourth embodiment is elastic and impact resistant. The electromagnetic-shielding gasket 341 can fit a clearance with a complicated configuration, and thus make the housing 343 watertight and airtight.

An electromagnetic-shielding gasket 453 constituting a fifth embodiment is also made of a sponge-like rubber. As shown in Figure 6, the electromagnetic-shielding gasket 453 has an inverted T-shaped cross-section, and has a nickel or copper layer 455 of about two microns in thickness applied by an evaporation process onto its surface.

Figure 7 shows an electromagnetic-shielding gasket

557 constituting a sixth embodiment. An aluminium layer 559 of about three microns in thickness is applied by an evaporation process onto the surface of a cylindrical sponge-rubber electromagnetic-shielding gasket 557.

The metallic membrane of two to four microns in thickness applied onto the surface of the electromagnetic-shielding body provides an electromagnetic-shielding effect without affecting the elasticity of the body.

Although specific embodiments of the invention have been described for the purpose of illustration, the invention is not limited to the embodiments illustrated and described. For example, the electromagnetic-shielding material of this invention is not limited to the electromagnetic-shielding gasket made of silicone rubber or sponge rubber. Other kinds of elastomer and synthetic resin could be used. The configuration of this material could be tubular or columnar, and its cross-section could be circular, elliptical, part-circular shaped, T-shaped, or L-shaped. The conductive membrane formed on the surface of the body material could be aluminium, titanium, nickel, copper, or another metallic layer. Furthermore, this material could be used at any joint section between components.

CLAIMS

1. An electromagnetic-shielding gasket or sealing member for sealing gaps and for preventing electromagnetic waves from passing through the gaps, comprising
a gasket or seal body formed of a synthetic elastomeric resin material, and
a conductive membrane applied by an evaporation process onto a surface of the gasket or seal body.

2. An electromagnetic-shielding gasket or sealing member as claimed in claim 1, in which the gasket or seal body is formed of a silicone rubber.

3. An electromagnetic-shielding gasket or sealing member as claimed in claim 1, in which the gasket or seal body is formed of a sponge-like rubber.

4. An electromagnetic-shielding gasket or sealing member as claimed in any preceding claim, in which the conductive membrane covers all exterior surfaces of the gasket or seal body.

5. An electromagnetic-shielding gasket or sealing member as claimed in any preceding claim, in which the conductive membrane is metallic.

6. An electromagnetic-shielding gasket or sealing member as claimed in claim 5, in which the conductive membrane comprises aluminium.

7. An electromagnetic-shielding gasket or sealing member as claimed in claim 5, in which the conductive membrane comprises titanium.

8. An electromagnetic-shielding gasket or sealing member as claimed in claim 5, in which the conductive membrane comprises nickel-copper alloy.

9. An electromagnetic-shielding gasket or sealing member substantially as hereinbefore described with reference to and as illustrated in the any of the accompanying drawings.

10. A housing for electronic components provided with a sealing gasket or sealing member as claimed in any preceding claim.

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